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Venous port catheter implantation for chemotherapy: Our experience in pediatric cases

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Abstract
Aim: The use of central venous access devices and especially venous port catheters is increasing day by day due to frequent venous interventions and long-term and painful treatment in chemotherapy treatment of cancer patients. In this study, we aimed to evaluate the applications of chemotherapy port-catheters in pediatric patients.
Material and Methods: Between 2014 and 2017, 76 pediatric cancer patients who were inserted venous port catheters for chemotherapy treatment in our hospital were evaluated retrospectively. Demographic data, diagnoses, port implantation site, and complications observed during and after the procedure were examined. The ports were placed under general anesthesia. Fluoroscopy was used during port placement, but not ultrasound.
Results: The mean age of the patients was 6.88 ± 4.79 (1-16) years and consisted of 31 (40.8%) female and 45 (59.2%) male patients. A chemotherapy port-catheter was inserted through the right subclavian vein in 48 patients, the left subclavian vein in 27 patients, and the right internal jugular vein in 1 patient. Five French (n=46; 60.5%), 6Fr (n=18; 23.7%) and 7Fr (n=12; 15.8%) port catheters were used for the number of patients involved. Arterial puncture was seen in 17 patients. Infection developed in 12 patients who received antibiotic therapy. Resorbed pneumothorax developed in one (1.3%) patient. No malposition was observed during the procedure.
Discussion: Despite some complications that may occur during chemotherapy port-catheter implantation in patients who will receive chemotherapy, it is a preferred method in terms of patient comfort. It is recommended to use imaging methods during and after the procedure to reduce complications.

Keywords
Child, Port catheters, Fluoroscopy, Vascular access, Ultrasound imaging

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Introduction

Intravenous administration of chemotherapeutic agents in oncology and hematology patients, their long-term parenteral alimentation, blood transfusions, providing comfort for these patients, and facilitation of the maintenance of home-therapies make chemotherapy port-catheter implantation an important issue. Venous port applications relieve children and their parents from the stress of searching for an appropriate venous route, increase the quality of life, confidence in medical care, and adherence to treatment [1-3]. Its application can be achieved under local or general anesthesia. The use of central venous access devices and especially venous port catheters in chemotherapy treatment in cancer patients is increasing day by day.

Implantation of a chemotherapy port catheter has become a common interest of anesthetists, general surgeons, chest surgeons, radiologists, cardiovascular surgeons. In our study, we aimed to evaluate the pediatric applications of chemotherapy port-catheters performed in our clinic.

Material and Methods

The study was approved by the ethics committee (KAEK/2015.14.5) and was conducted in accordance with the Helsinki Declaration. This study was performed with patients registered in our database who had been referred to the clinic of pediatric hematology and oncology of our hospital for chemotherapy port-catheter implantation. In our study, a total of 76 patients who were referred to our clinic between 2014, and 2017 for implantation of chemotherapy port-catheter were evaluated.

Before the procedure, the patients were evaluated for their general health status, the presence of bleeding diathesis, and vascular access site to be used for intervention. The relatives of the patients were told before the procedure about the the upcoming procedure, its potential complications, and the purpose of the procedure; then they completed a procedural consent form. Peripheral vascular access was opened, the sterile drape was placed, and under general anesthesia, priorly subclavian vein because of easy of application, and secondly internal jugular veins were preferred. Reservoirs were placed on the midclavicular line, and on the pectoral muscle creating a port pocket, and the catheter was implanted. Ultrasound was not used during the procedure, but fluoroscopy was used. After the procedure, the port catheter was irrigated with physiologic saline, and the reservoir was filled with diluted heparin (2500 U standard heparin in 10 cc physiologic saline). After the procedure, control chest radiograms were obtained within the first two hours, and 24 hours later. The location of chemotherapy port-catheter was evaluated as for hemothorax, and pneumothorax. After implantation, when wound healing was achieved, chemotherapy sessions were initiated.

Statistical analysis

Analysis of data was carried out using SPSS 21 program (Chicago, IL, USA). Data were expressed as numbers and percentages. The Chi-square test was utilized to compare groups. Logistic regression analysis was performed to assess the impact of variables on the occurrence of arterial puncture. A p-value less than 0.05 was considered statistically significant.

Results

Port catheters were implanted in 76 patients in our clinic. The mean age of the patients was 6.88 ± 4.79 (range, 1 to 16) years, the study population consisted of 31 (40.8%) female, and 45 (59.2%) male patients. Chemotherapy port-catheter was implanted with the indications of acute lymphoblastic leukemia (ALL) (n=60; 79.0%), acute myeloid leukemia (AML) (n=8; 10.5%), non-Hodgkin lymphoma (NHL) (n=3; 2.6%), neuroblastoma (n=2; 2.6%), and malignant neoplasm of soft tissue (n=1; 1.3%). Five French (n=46; 60.5%), 6Fr (n=18; 23.7%), and 7Fr (n=12; 15.8%) port catheters were used for respective number of patients. An overview of baseline descriptives is presented in Table 1. The relationship between the studied variables and occurrence of complications such as pneumothorax, arterial puncture and port infection is demonstrated in Table 2. Accordingly, arterial puncture was more often encountered in patients receiving procedure on the left side (p=0.013) and who undergo more than 1 intervention (p<0.001).

Table 1. Distribution of baseline descriptives in this series.

Variable		Number (%)
Age	≤ 6	42 (55.3)
	>6	34 (44.7)
Site of intervention	Right	48 (63.2)
	Left	28 (35.5)
Number of procedures	1	56 (73.7)
	2	20 (26.3)
Complications	Pneumothorax	1 (1.3%)
	Arterial puncture	17 (22.4)
	Port infection	12 (15.8)

Table 2. Relationship between complications and variables.

Variable		Age		p-value
		≤6	>6	
Arterial puncture	No	31 (73.8%)	28 (82.4%)	0.374
	Yes	11 (26.2%)	6 (17.6%)	
Pneumothorax	No	42 (100%)	33 (97.1%)	0.447
	Yes	0	1 (2.9%)	
Port infection	No	36 (85.7%)	28 (82.4%)	0.689
	Yes	6 (14.3%)	6 (17.6%)	
		Site of intervention		
		Right	Left	
Arterial puncture	No	43 (87.7%)	17 (63%)	0.013*
	Yes	6 (12.3%)	10 (37%)	
Pneumothorax	No	47 (97.9%)	27 (100%)	1.000
	Yes	1 (2.1%)	0	
Port infection	No	42 (87.5%)	22 (81.5%)	0.511
	Yes	6 (12.5%)	5 (18.5%)	
		Number of procedures		
		1	2	
Arterial puncture	No	50 (89.3%)	9 (47.4%)	<0.00*
	Yes	6 (10.7%)	10 (52.6%)	
Pneumothorax	No	55 (98.2%)	19 (100%)	1.000
	Yes	1 (1.8%)	0	
Port infection	No	48 (85.7%)	16 (84.2%)	1.000
	Yes	8 (14.3%)	3 (15.8%)	

*: statistically significant

Arterial puncture was observed in 17 (22.4%) patients. Infection developed in 12 (15.8%) patients who were treated with antibiotherapy. Pneumothorax developed in one (1.3%) patient and resorbed. Complications such as wound site hematoma and inappropriate orientation of the port catheter were not observed in any patient. More than one procedure for vascular access was associated with 13.827 times increased risk for arterial puncture (p=0.027).

Discussion

Many chemotherapeutic agents damage the vein wall and occlude venous route. If the administered drug extravasates, it may cause cellulitis, phlebitis, and tissue necrosis. Chemotherapy port-catheters ensure a long-term and reliable venous route, and play an active role in the treatment of oncology, and hematology patients [4].

Early and late-term complications may be seen related to the implantation of chemotherapy port-catheters. Early-term complications include pneumo-hemothorax, malposition, malfunction of the catheter, arrhythmia, cardiac perforation, port pocket site infection, arteriovenous fistula, left thoracic duct lesion, and phrenic or brachial plexus lesion. Late-term complications include skin necrosis, broken catheter, catheter embolus, infection, catheter occlusion, and disconnection, difficulty in both localization of the port site, and aspiration of blood, and extravasation of fluids [4,5].

In recent years, any difference has not been observed in the techniques of port implantations performed by surgeons, and radiologists in many centers. The use of fluoroscopy and ultrasound in radiology confers an advantage. In our study, during punctures, Doppler ultrasound was not used because of technical inadequacies. These technical inadequacies naturally constitute disadvantages. Arterial puncture, which is the most frequently observed complication is a result of this condition. However, this disadvantage did not prevent us from carrying out this procedure, which should be performed within the facilities of our hospital. Not all clinics in Turkey and in the world implant port catheters under ultrasonographic guidance. The greatest advantage of ultrasound is to decrease the risk of arterial punction. Port-catheter implantation under radiological guidance decreases procedure-related complications like pneumothorax, hemothorax, and catheter malposition [6]. Subclavian vein was generally preferred for our port applications, and in only one case, jugular vein was preferred because of difficulty in subclavian access. In the literature, the incidence of pneumothorax varies between 0.1, and 3.2% [6]. In one of our patients (1.3%) pneumothorax was seen. The incidence of pneumothorax was in compliance with the data reported in the literature. We noted that repeated procedures and interventions on the left side were associated with a higher rate of complications.

During implantation of chemotherapy ports through the subclavian vein, catheter may be caught, and then breaks between the clavicle, and the first rib, leading to the emergence of pinch-off syndrome [5]. In our patients, pinch-off syndrome did not develop. The tendency to hypercoagulation and deep vein thrombosis may develop secondary to infusion of chemotherapeutic agents and catheterization in cancer patients. Deep vein thrombosis did not develop in our patients. Catheter-related thrombosis and infection are the most frequently encountered serious complications of vascular ports, with reported incidence rates ranging between 0-7.7% and 1.5-13%, respectively [7,8]. Catheter-related thrombosis did not develop in our patients. Diluted heparin delivered into the reservoir during the procedure decreases formation of thrombosis. Chemotherapeutic drugs given during treatment mostly depress immune system of cancer patients, and these patients are more prone to infection [9]. Though the definition of port catheter- related infections differs in different studies, and among many authors, conditions characterized by the presence of bacteria on the surface of catheter without clinical findings of bacteremia or inflammation, signs of local infection at the access site of catheter not accompanied by systemic infection, detection of the growth of the same microorganism in blood cultures of peripheral blood specimens, and catheter, presence of septic thrombophlebitis, hyperemia, purulent discharge, and tenderness elicited by palpation on the tunnel or port pocket site are termed as port catheter infection [10]. As reported in the literature, the incidence of chemotherapy-related port-catheter infection ranges between 2.6, and 9 percent [11]. In the literature, the incidence of port pocket site infection has been reported between 0.3, and 4.4 percent [8]. In our series, catheter-related infection was observed in 12 (15.8%) patients. Frequently, staphylococcus epidermidis, staphylococcus aureus and candida spp. Are held responsible for catheter-related infection [12-14]. According to the literature, removal of the port is not advised for every patient carrying signs of infection. In the presence of persistent sepsis/bacteremia, infection refractory to antibiotherapy or signs of port tunnel infection, systemic complications (septic thrombosis/embolism, osteomyelitis, abscess formation or endocarditis), certain microorganisms as S. aureus or Candida spp. and in unstable patients (those with port infection, and hypotension), port catheter should be removed [15]. In our study, port catheter was withdrawn because of a catheter-related infection. The risk of port infection increases in patients whose wound healing is delayed because of the use of chemotherapeutic agents, state of disability, and sickness.

Conclusion

Despite some complications that may occur during chemotherapy port-catheter implantation in patients who will receive chemotherapy, it is a preferred method in terms of patient comfort. In our study, more than one procedure and intervention on the left side was associated with a higher complication rate. It is recommended to use imaging methods during and after the procedure to reduce complications.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

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Conflict of interest

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